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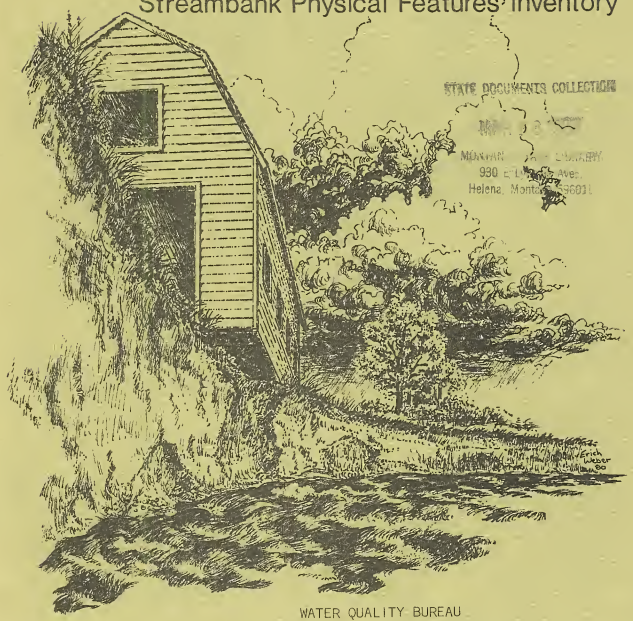
THE MUSSELSHELL RIVER

Streambank Physical Features Inventory



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THE MUSSELSHELL RIVER
STREAMBANK PHYSICAL FEATURES INVENTORY

Prepared for:

Statewide Section 208
Water Quality Management Planning
Land Use/Water Quality Relationships

by:
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Water Quality Bureau
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Helena, Montana 59601

February, 1980

Acknowledgements

The Musselshell River Streambank Physical Features Inventory was conducted by Loren L. Bahls, Head of Water Quality Management Section; Robert N. Greene, Environmental Specialist; Gordon Hills, Environmental Specialist; Gary L. Ingman, Environmental Specialist and Richard J. Pedersen, Environmental Specialist, Water Quality Bureau, Department of Health and Environmental Sciences. Preparation for the inventory was made with the assistance of R. F. Batchelor, Biologist, Soil Conservation Service. The talents of Erich Weber were employed for cover artistry. Ardis Steinmetz was the typist.

Abstract

The Musselshell River Streambank Physical Features Inventory was conducted during the fourth week of June (24-29), 1979. As a result of the inventory 51,220 feet of stream channel alterations, 34,680 feet of rock riprap, 3,320 feet of log riprap, 45 rock jetties, 158 car bodies, 11 irrigation diversion dams, 60 pump sites, 291 snags and 527,110 feet of eroded banks were identified and measured on the Musselshell River from Shawmut to Melstone, a distance of 159.5 river miles. Sixty-nine percent of the eroded banks were judged as critical sediment sources.

Channel alteration and realignments by the Milwaukee Railroad dominate man's impact to the river although streambank erosion has been aggravated severely by farming and grazing to the river's edge. Establishment and/or maintenance of a protective corridor of deep-rooted, woody vegetation along the river would be a conservation measure for the control of streambank erosion on the Musselshell River.

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Introduction

This report shows the results of a 1979 streambank inventory of the Musselshell River from Shawmut to Melstone (Figures 1 & 2), a distance of 159.5 river miles. Quantitative measurements were made of the following streambank characteristics: channel alterations, rock riprap, car bodies, rock jetties, irrigation diversions, eroded banks and critical sediment sources.

Increased sediment loads continue to present considerable water quality problems in the Musselshell Basin. Fisheries production, recreation, domestic water use, irrigation and reservoir storage are all affected.

Along with runoff from adjacent lands, the stream corridor can be a significant source of sediment. A stream is able to erode because of the energy it generates while moving downstream. The degree of erosion is dependend upon many factors, including the physical characteristics of the stream, the land it flows through and riparian vegetation. Any changes in these factors can alter the degree of streambank erosion.

With the advent of economic growth, settlement and transportation, land use along stream corridors has changed. In many instances such changes have caused an increase in streambank erosion. Channel straightening increases water velocity, resulting in bank cutting both upstream and downstream of the alteration. Farming and grazing to a stream's edge frequently removes grasses and willows necessary for natural streambank protection.

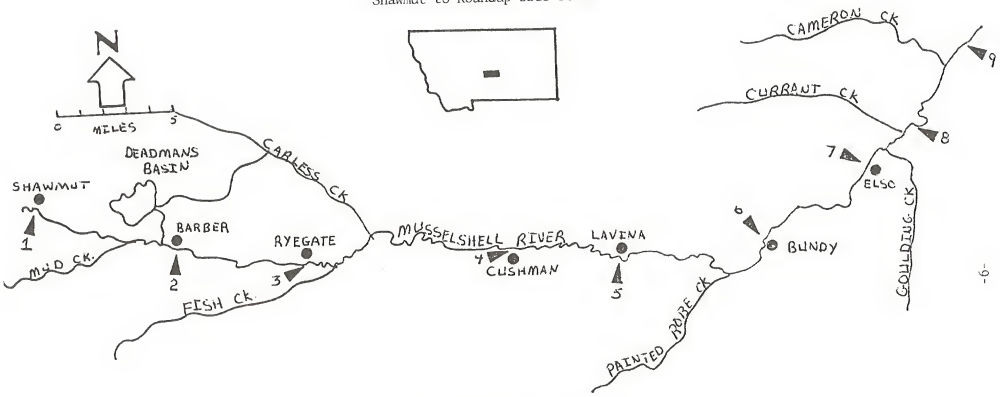
The Musselshell River Streambank Physical Inventory was conducted as part

of an environmental assessment to determine sources of water quality impairment to the Musselshell River. The information from this report, along with water quality data and a basin land use inventory, will afford a detailed look at the physical, biological and chemical nature of the river and identify areas of water quality impairment and their sources. When all available information has been assembled and evaluated, a report will be written making more specific recommendations to various resource management and planning agencies, irrigation districts and private water users and developers that will improve water quality of the Musselshell River.

Figure 1

MUSSELSHELL RIVER

Shawmut to Roundup USGS Station



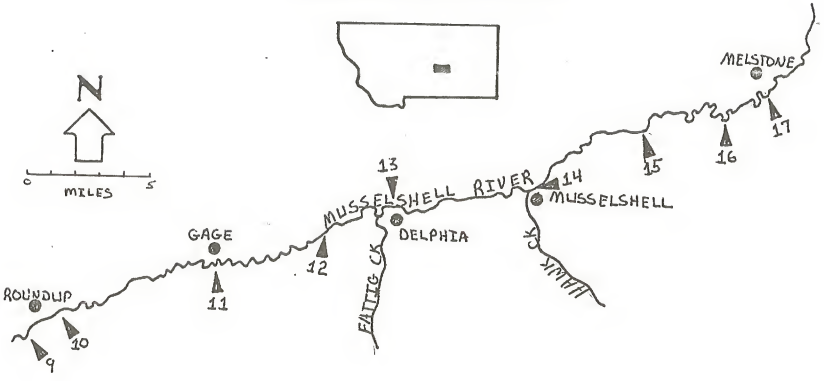
Inventory Access Points

1. Shawmut
2. Barber
3. Ryegate
4. Cushman
5. Lavina
6. Bundy
7. Elso
8. Hiway 381
9. Roundup USGS Station

Figure 2

MUSSELSHELL RIVER

Roundup USGS Station to Melstone



Inventory Access Points

9. Roundup USGS Station
10. Below Roundup
11. Gage
12. Bridge Crossing Section 1
13. Delphia
14. Musselshell
15. Queen's Point
16. 3 Miles SW of Melstone
17. Melstone

Setting

The mainstem of the Musselshell River forms at the juncture of the North and South Forks of the Musselshell River near Martinsdale in Wheatland County. It then flows easterly for 200 miles through Wheatland, Golden Valley and Musselshell Counties, then northwest for 50 miles along the west side of Petroleum County and empties into the Missouri River near the upper end of Fort Peck Reservoir.

The Musselshell River and its tributaries drain an area of approximately 8,000 square miles. Mountain ranges contributing to the watershed are the Castles to the west, the Little Belts to the northwest, the Crazies to the southwest, the Snowys to the north and the Bull Mountains to the south.

With headwaters originating at 9,200 feet above sea level, the Musselshell River drops over 7,000 feet to its mouth. The average annual discharge of the river at Mosby is 265 cubic feet per second or 192,000 acre-feet per year (USGS, 1977).

Five stations are monitored continuously for flow by the United States Geological Survey. A summary of this flow data is presented in tables one through five.

The Musselshell River Basin can be described as having a cool, semiarid climate receiving 11 to 16 inches of precipitation annually and having an average annual temperature ranging from 43.2°F to 47.1°F. Temperatures vary considerably from season to season. The highest recorded temperature in the basin is 108°F at Flatwillow and the lowest is -54°F at Harlowton (BLM, 1971).

Soils in the eastern part of the Musselshell River Basin are generally clays or clay loams with varying depths to bedrock. Most soils in the Bull Mountains are silt loams and fine sandy loams, ranging from a few inches to several feet deep. The western portion of the basin has moderately deep, well drained loams and clay loams on the benchlands, highly calcareous, loamy soils on the terraces and loamy or sandy textured soils on the alluvial fans (Kaiser and Botz, 1976).

Table 1

Average Monthly Flow Data from the Musselshell River at Harlowton (cfs).

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Yearly Average
1957	45	64	51	40	41	63	71	373	720	226	85	76	155
1958	86	85	64	55	80	82	132	204	91	78	59	28	87
1959	39	54	63	74	60	108	74	137	645	161	107	94	134
1960	86	80	77	55	52	127	88	263	186	75	62	32	99
1961	59	66	63	59	58	44	33	23	30	22	4	5	39
1962	4	34	38	38	46	54	44	385	508	135	89	67	120
1963	96	92	90	49	95	76	65	297	498	174	89	59	140
1964	45	74	70	56	48	55	78	244	762	173	113	36	146
1965	33	37	74	89	100	78	234	357	602	204	126	254	182
1966	191	131	105	74	79	152	123	347	161	143	88	40	137
1967	47	68	61	52	48	82	171	599	1842	343	142	91	295
1968	88	111	87	74	126	133	129	267	624	175	152	94	171
1969	99	109	54	63	77	266	531	155	185	207	105	40	158
1970	68	88	71	51	59	56	106	870	699	190	83	95	204
1971	91	75	91	71	124	96	235	437	270	145	96	102	153
1972	110	106	49	55	73	235	168	304	290	93	150	119	146
1973	94	95	47	41	45	66	56	39	86	35	22	30	55
1974	54	70	67	93	59	95	124	199	644	194	192	83	156
1975	70	98	59	49	58	119	293	1037	182	751	189	137	391
1976	148	154	206	147	135	132	275	1266	485	180	172	92	284
1977	115	103	84	75	99	69	90	135	132	69	68	59	56

Maximum Discharge: 5,240 cfs June 19, 1975.
Minimum Discharge: 0.1 cfs August 28, to September 2, 1949, March 29, 1950.

Source: USGS (1957-1977).

Table 2

Average Monthly Flow Data from the Musselshell River at Ryegate (cfs).

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Yearly Average
1957	28	39	27	13	20	44	23	388	1106	335	135	153	192
1958	118	147	92	78	84	92	100	244	174	174	123	100	126
1959	47	50	31	31	46	209	43	98	580	149	169	104	130
1960	44	51	50	37	57	90	73	182	176	158	119	44	90
1961	18	22	17	21	24	22	64	90	139	112	44	5	48
1962	3	11	9	7	15	36	18	263	396	123	62	47	83
1963	44	66	36	14	85	38	25	164	593	202	159	42	122
1964	51	38	21	19	20	21	26	102	896	239	154	68	137
1965	44	38	46	74	90	49	173	199	620	242	195	288	171
1966	167	93	109	65	80	182	160	272	157	178	125	94	141
1967	47	28	51	51	49	90	51	412	3427	630	189	138	428
1968	72	89	56	76	153	175	156	293	669	216	127	95	181
1969	53	103	86	73	93	381	419	131	241	132	122	80	159
1970	72	77	64	36	56	69	76	720	746	287	147	104	205
1971	50	38	37	29	217	107	227	477	276	220	141	145	163
1972	51	70	41	41	95	307	73	262	286	182	227	159	150
1973	51	36	9	15	29	50	47	96	133	128	92	28	60
1974	26	43	29	139	43	52	47	140	435	231	186	85	122
1975	63	72	55	38	59	143	567	1232	2627	1389	346	216	568
1976	189	189	255	175	189	202	211	1818	580	250	205	132	368
1977	60	133	70	81	115	74	57	131	102	82	88	38	86

Maximum Discharge: 9,500 cfs June 16, 1967.
Minimum Discharge: no flow August 17-28, 1946.

Source: USGS (1957-1977).

Table 3

Average Monthly Flow Data from the Musselshell River at Roundup (cfs).

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Yearly Average
1957	17	43	32	18	26	57	35	329	1030	303	102	181	181
1958	124	162	91	82	92	121	105	184	200	180	134	121	133
1959	42	58	36	34	51	421	76	119	570	198	180	105	158
1960	52	53	52	38	67	128	100	173	154	209	150	59	103
1961	24	30	22	26	28	19	55	65	140	115	49	8	48
1962	8	15	11	7	32	79	29	250	592	199	128	91	120
1963	68	84	61	24	104	64	38	156	586	198	198	63	137
1964	59	46	26	29	36	38	38	112	1026	327	291	114	178
1965	52	43	29	108	171	117	324	304	764	325	248	362	236
1966	226	113	112	101	110	262	255	330	198	236	197	137	190
1967	67	41	56	53	53	123	89	428	4315	766	305	191	538
1968	120	121	72	130	237	289	292	376	958	325	295	189	283
1969	90	154	112	101	124	566	554	224	389	216	205	171	242
1970	100	75	69	38	66	134	159	883	812	317	233	167	255
1971	83	68	59	47	414	179	305	463	344	284	190	196	218
1972	90	88	51	51	190	428	110	320	298	244	267	186	194
1973	78	61	29	30	54	96	82	182	142	174	105	54	91
1974	35	59	50	115	89	83	69	156	442	209	290	141	145
1975	71	88	60	39	57	153	788	1369	2613	1308	477	266	608
1976	233	214	283	222	246	251	259	1811	689	328	271	226	421
1977	99	139	153	113	156	108	83	180	128	88	124	58	119

Maximum Discharge: 9,610 cfs June 18, 1967.
Minimum Discharge: 0.60 cfs May 12, 1962.

Source: USGS (1957-1977).

Table 4

Average Monthly Flow Data from the Musselshell River at Musselshell (cfs).

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Yearly Average
1957	11	47	33	20	27	64	39	309	1039	326	82	180	181
1958	114	158	101	91	91	124	110	160	184	152	95	109	124
1959	46	64	40	35	51	749	88	106	526	169	135	99	176
1960	60	50	55	39	74	155	115	149	118	138	110	46	93
1961	24	29	26	22	28	19	41	40	91	59	25	6	34
1962	9	16	12	9	46	108	36	231	618	175	82	87	119
1963	62	75	68	19	133	64	39	129	536	170	145	59	123
1964	48	45	26	27	29	35	40	97	973	302	211	116	162
1965	46	43	33	139	220	135	315	326	688	349	191	336	234
1966	229	126	133	110	100	286	260	310	165	191	152	111	182
1967	59	38	53	53	54	107	91	386	4223	821	264	183	525
1968	124	110	67	98	223	303	286	371	974	321	267	177	276
1969	97	140	112	103	130	601	594	220	368	243	155	150	243
1970	107	73	66	43	75	145	155	1138	1038	249	190	151	287
1971	82	66	66	54	460	184	296	405	289	214	144	199	203
1972	95	83	51	54	226	500	122	328	272	187	235	169	194
1973	82	65	36	35	57	104	74	180	114	116	67	62	83
1974	46	59	51	117	97	88	74	143	430	157	251	148	138
1975	78	91	61	48	64	206	859	1481	2299	1376	448	277	609
1976	260	236	269	222	246	269	273	1670	716	296	234	211	410
1977	101	141	155	118	159	118	84	149	102	50	81	60	110

Maximum Discharge: 9,850 cfs June 19, 1967
Minimum Discharge: no flow at times.

Source: USGS (1957-1977).

Table 5

Average Monthly Flow Data from the Musselshell River at Mosby (cfs).

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Yearly Average
1957	4	36	34	21	50	100	53	295	993	281	20	150	169
1958	104	155	88	96	112	154	112	70	175	114	32	60	106
1959	42	58	44	35	47	698	191	125	469	143	47	71	250
1960	58	50	65	41	82	460	126	98	54	21	42	16	93
1961	11	26	26	18	37	19	23	13	10	0	0	17	16
1962	1	18	6	2	31	123	47	889	1604	434	70	70	275
1963	54	71	62	21	220	76	46	83	510	100	79	64	114
1964	28	44	28	22	34	48	53	98	1038	246	184	124	161
1965	43	47	29	134	423	259	457	466	645	275	114	316	265
1966	233	125	111	104	85	411	266	245	87	127	70	71	162
1967	67	41	45	51	74	139	128	484	4967	1095	194	179	619
1968	133	133	83	95	231	427	324	355	2147	486	285	182	405
1969	113	207	162	121	145	1006	818	237	394	795	90	111	416
1970	102	84	69	40	113	236	172	2796	1621	203	107	145	477
1971	97	89	81	65	1858	639	545	527	270	123	56	197	368
1972	101	95	57	65	413	1404	228	413	474	98	276	148	315
1973	100	77	36	46	87	120	286	364	138	44	14	51	114
1974	48	71	62	173	128	113	103	274	658	109	131	159	169
1975	78	106	80	51	81	223	1273	3772	3451	2153	465	282	1006
1976	304	280	252	310	326	347	313	1673	735	239	162	174	427
1977	103	134	191	119	224	171	140	125	70	24	20	71	115

Maximum Discharge: 18,000 cfs June 18, 1944.
Minimum Discharge: no flow at times.

Source: USGS (1957-1977).

Land use in the basin is predominantly privately-owned rangeland which comprises 67 percent of the total basin. Irrigated acreage has been growing steadily and accounts for around 100,000 acres or 2.2 percent of the basin area. Three state-built reservoirs supply water for irrigation. Durand Reservoir is located on the North Fork of the Musselshell River, about one-half mile above Delphine, and has a storage capacity of 7,029 acre-feet. Martinsdale Reservoir, with a storage capacity of 23,195 acre-feet, is located about one mile southeast of Martinsdale. Deadman's Basin Reservoir, located about 21 miles east of Harlowton, has a storage capacity of 80,570 acre-feet (Water Resources Survey, 1949).

The Milwaukee Road line through Roundup and Harlowton was completed in 1908, bringing economic and population growth to the basin. Many problems were encountered during construction of the railroad. The following account was given in the April 17, 1958 issue of The Roundup Record-Tribune:

> "While the Musselshell River gave good water and the valley's cottonwood trees furnished fuel, the channel changes made in the Musselshell to save bridging entailed not only large amounts of riprapping, but brought about serious complications in irrigation systems, in many cases requiring the construction of inverted siphons to carry irrigation ditches across the roadbed and of entirely new systems of dams, head gates and ditches to satisfy the demands of the owners and, as an aftermath, required the company's right-of-way agents to spend months of time and thousands of dollars in the work of settling claims for damages."

The Musselshell River from Barber upstream is considered an average to above average cold water fishery with populations of native cutthroat trout. The fishery from Barber to Roundup is considered marginal with trout being scarce and a few warm water species found in the lower section. From Roundup downstream, the river supports a substantial resident warm water fish population (Wiedenheft, 1979).

Procedures and Results

The Musselshell River Streambank Physical Features Inventory was conducted by a five-man survey party during the fourth week of June (24-29), 1979. A ground crew of two made water quality observations and provided logistical support to the remaining three who floated the river in sections from Shawmut to Melstone using a 14-foot aluminum "Jon" boat. Streambank observations were recorded on stream inventory field forms and on large scale (1" = 250') aerial photographs taken in February of 1976 (obtained from the U.S. Department of Agriculture, Soil Conservation Service). The photographs were indexed for ease of use.

Observations recorded on field forms and aerial photographs included the following:

1. Stream channel alterations and realignment.
2. Streambank alterations.
    a. blanket rock riprap
    b. cabled log riprap
    c. car bodies
    d. rock jetties
3. Eroded banks
4. Critical sediment sources.
5. Snags.
6. Irrigation pumps and diversions.

Upon completion of the inventory, distances were measured directly from aerial photographs and recorded on stream inventory forms. All information was then recorded permanently on the photographs and cross-referenced to the inventory forms.

For this report, the Musselshell River from Shawmut to Melstone was divided into sixteen sections (Table 6). The sections begin and end at bridge crossings and were chosen for ease of access.

Stream Channel Alterations and Realignment

A total of 51,220 feet of stream channel alterations was identified on the Musselshell River from Shawmut to Melstone. This amounts to 6.0 percent of the total channel length (841,680 feet). Elimination of channel meanders is the most prominent form of channel alteration. Some realignments have been made in an attempt to protect agricultural land, however, most were made during the construction of the Milwaukee Railroad when the river had to be bridged or the channel changed 117 times between Melstone and Harlowton (Thor, 1958).

River Section	Channel Alteration (feet)	Percent of Section Channel Length
1	4,140	5.6
2	3,260	6.4
3	7,700	7.8
4	3,400	6.8
5	6,250	6.6
6	7,330	13.6
7	900	3.6
8	3,700	12.8
9	2,350	7.8
10	3,610	6.6
11	350	0.6
12	3,260	8.2
13	2,840	5.4
14	1,610	2.6
15	160	0.4
16	360	1.6
Total	51,220	6.0%

Streambank Alterations

Rock and log riprap, rock jetties and car bodies have all been used in an

Table 6

Inventoried Sections of the Musselshell River

Number	From	To	Channel Distance Feet	Channel Distance Miles	Bank Distance Feet L. Bank	R. Bank	Total
1	Shawmut	Barber	74,380	14.1	74,170	74,600	148,770
2	Barber	Ryegate	51,690	9.8	51,500	51,880	103,380
3	Ryegate	Cushman	98,590	18.7	98,540	98,630	197,170
4	Cushman	Lavina	50,650	9.6	50,550	50,750	101,300
5	Lavina	Bundy	93,480	17.7	94,090	92,860	186,950
6	Bundy	Elso	53,770	10.2	53,820	53,720	107,540
7	Elso	Hiway 381	25,040	4.7	25,000	25,080	50,080
8	Hiway 381	Roundup USGS Station	29,070	5.5	29,110	29,030	58,140
9	Roundup USGS Station	Below Roundup	29,990	5.7	29,920	30,050	59,970
10	Below Roundup	Gage	54,790	10.4	54,710	54,870	109,580
11	Gage	Bridge Crossing Sec 1	52,280	9.9	52,220	52,330	104,550
12	Bridge Crossing Sec 1	Delphia	39,210	7.4	39,320	39,100	78,420
13	Delphia	Musselshell	52,960	10.0	53,010	52,900	105,910
14	Musselshell	Queen's Port	62,620	11.9	62,710	62,520	125,230
15	Queen's Port	3 Mi. SW of Melstone	51,670	9.8	51,530	51,810	103,340
16	3 Mi. SW of Melstone	Melstone	21,490	4.1	21,390	21,590	42,980
Total	Shawmut	Melstone	841,680	159.5	841,590	841,720	1,683,310

attempt to protect and stabilize eroding streambanks on the Musselshell River. As a result of this inventory, a total of 34,680 feet of rock riprap, 3,320 feet of log riprap, 45 rock jetties and 158 car bodies were identified along the banks of the river.

River Section	Rock Riprap Feet	Rock Riprap Percent of Bank Length	Log Riprap Feet	Log Riprap Percent of Bank Length	Number of Rock Jetties	Number of Car Bodies
1	360	0.2	450	0.3	0	1
2	1,050	1.0	120	0.1	0	3
3	5,920	3.0	480	0.1	4	5
4	1,480	1.4	900	0.8	0	3
5	5,990	3.2	0	-	3	7
6	1,950	1.8	0	-	1	0
7	340	0.7	0	-	3	0
8	640	1.1	0	-	8	3
9	3,860	6.4	0	-	4	62
10	3,040	2.8	0	-	9	33
11	0	-	120	0.1	1	18
12	3,350	4.3	510	0.6	3	0
13	3,680	3.5	0	-	0	1
14	2,560	2.0	0	-	2	2
15	380	0.4	250	0.2	3	17
16	80	0.2	500	1.2	4	1
Total	34,680	2.1%	3,320	0.2%	45	158

Eroded Banks and Critical Sediment Sources

Over thirty-one percent (527,110 feet) of the Musselshell River's total bank length (1,683,100 feet) from Shawmut to Melstone was identified as eroding. Sixty-nine percent (364,190 feet) of the eroded banks were judged as critical sediment sources contributing silts and other fines to the river bottom.

For the purpose of this inventory, eroded banks were divided into five categories. Minor eroded banks were less than six inches high, had good root mass and no evident mass wasting. Minor to moderate eroded banks were from six to twelve inches high with good root mass and no mass wasting. Moderate eroded banks were from twelve to twenty-four inches high, had fair to good root mass and no mass wasting. Moderate to major eroded banks were greater than twenty-four inches, had fair root mass with

some evidence of mass wasting. Major eroded banks were greater than twenty-four inches high, had poor root mass and severe mass wasting. Moderate to major and major eroded banks were considered critical sediment sources.

Section	Eroded Banks Feet (Percent of Bank Length) Minor	Min.-Mod.	Moderate	Mod.-Maj.	Major	Total
1	8,420(5.7)	2,530(1.7)	6,750(4.5)	4,360(2.9)	2,090(1.4)	24,190(16.3)
2	4,240(4.1)	7,960(7.7)	9,520(9.2)	6,410(6.2)	3,740(3.6)	31,870(30.8)
3	7,220(3.7)	7,190(3.6)	10,410(5.3)	14,330(7.3)	12,450(6.3)	51,600(26.2)
4	3,670(3.6)	1,580(1.6)	7,480(7.4)	10,490(10.4)	13,340(13.2)	36,550(36.1)
5	4,570(2.4)	2,580(1.4)	15,130(8.1)	12,500(6.7)	30,740(16.4)	65,520(35.0)
6	2,020(1.9)	1,390(1.3)	5,660(5.3)	9,750(9.1)	12,920(12.0)	31,740(29.5)
7	380(0.8)	820(1.6)	5,570(11.1)	5,790(11.6)	6,210(12.4)	18,770(37.5)
8	1,650(2.8)	210(0.4)	2,890(5.0)	7,960(13.7)	3,620(6.2)	16,330(28.1)
9	1,440(2.4)	1,340(2.2)	3,210(5.4)	4,860(8.1)	4,080(6.8)	14,930(24.9)
10	560(0.5)	1,720(1.6)	4,760(4.4)	9,000(8.2)	24,310(22.2)	40,360(36.8)
11	0(0)	300(0.3)	6,340(6.1)	12,020(11.5)	22,780(21.8)	41,440(39.6)
12	0(0)	0(0)	4,000(5.1)	3,530(4.5)	16,720(21.3)	24,250(30.9)
13	0(0)	250(0.2)	1,740(1.6)	9,560(9.0)	22,760(21.5)	34,310(32.4)
14	1,390(1.1)	220(0.2)	5,520(4.4)	10,700(8.5)	22,480(18.0)	40,310(32.2)
15	250(0.6)	0(0)	6,140(5.9)	17,810(17.2)	14,810(14.3)	39,010(37.8)
16	0(0)	750(1.8)	3,110(7.2)	5,840(13.6)	6,230(14.5)	15,930(37.1)
Total	35,810(2.1)	28,940(1.7)	98,230(5.8)	144,910(8.6)	219,280(13.0)	527,110(31.1)

Irrigation Takeoffs

Eleven irrigation diversion dams and sixty pump sites were identified at the time of the inventory. These contribute to the annual diversion of 103,000 acre-feet of water from the Musselshell River above Mosby (USGS, 1977).

Section	Pump Sites	Diversion Dams
1	2	0
2	3	0
3	7	1
4	2	1
5	10	1
6	0	2
7	3	0
8	3	1
9	7	0
10	10	0
11	4	1
12	1	1
13	5	1
14	0	2
15	3	0
16	0	0
Total	60	11

Snags

A total of 291 log jams and fallen trees obstructed portions of the river channel from Shawmut to Melstone. Sediment is deposited around these snags and water velocity is slightly altered causing a minor increase in bank erosion. During low flow, river floaters could have considerable problems negotiating these snags.

River Section	Number of Snags
1	22
2	14
3	26
4	14
5	27
6	24
7	17
8	7
9	10
10	26
11	13
12	5
13	20
14	32
15	19
16	15
Total	291

Conclusions

Channel alterations and realignments by the Milwaukee Railroad dominate man's impact to the Musselshell River from Shawmut to Melstone. The railroad has narrowed the alluvial valley in many areas, reducing the stream's sinuosity and increasing its gradient and velocity. As a result, the erosive potential of the river has been accelerated.

Streambank erosion has been aggravated by farming and grazing to the river's edge. Almost all critical sediment sources (moderate to major and major eroded banks) are in areas where woody plant species are missing from streambanks. Pasturing, grazing and/or haying to the river's edge have caused the native deep-rooted, woody plants to be replaced by shallow-rooted grasses and forbs with little of the root mass necessary to protect streambeds from eroding. In areas where native woody vegetation predominates, streambank erosion is minimal or absent all together.

Rock riprap has effectively stabilized some streambanks on the Musselshell River. The future use of this type of bank stabilization will be reduced due to no further financial assistance from U. S. Department of Agriculture cost share programs.

Streambank erosion is a major contributor of sediment to the Musselshell River, resulting in water quality degradation. Significant amounts of sediment are being deposited on the river's bottom and long reaches of gravel riffles are being filled with silt, posing a threat to the river's fish and invertebrate habitat. The expense of rock riprap limiting its use by landowners leaves the establishment of a protective corridor of deep-rooted, woody vegetation along the river as the alternative measure for the control of streambank erosion.

The highly erodible soils of the basin and the many channel realignments by

the Milwaukee Railroad dictate that the Musselshell River will always have eroding banks and sediment on its bottom; but with proper agricultural practices along the river corridor, streambank erosion could be lessened and the quantity of sediment reaching the river reduced.

Flow of the Musselshell River during the inventory period averaged 600 cfs at Harlowton which is considerably higher than normal. For this reason, areas of slight erosion may have been covered but those areas of severe streambank erosion were accented by seeing them at a time when the river's erosive potential was great. In some cases, active mass wasting was observed by team members. It is the author's opinion that the high flow conditions did not adversely affect the inventory.

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